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## (54) NONWOVEN FABRIC FOR ALKALINE STORAGE BATTERY SEPARATOR AND MANUFACTURING METHOD THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a nonwoven fabric having satisfactory short-circuit preventing function, superior in affinity to an electrolyte and having satisfactory workability in a battery assembly process.

SOLUTION: This non-woven fabric for an alkaline storage battery is obtained by forming slurry, where 50-80 pts.wt. of nylon fiber, 50-20 pts.wt. of thermally fused fiber and 5-10 pts.wt. of polyvinyl alcohol binder fiber in the total amount of 100 parts of the nylon fiber and thermally fused fiber are mixed into a paper-like form by a wet paper manufacturing method. Preferably in this case, the electrolyte absorbing rate is 100 mm/30 min or higher, the width contraction rate is 6% or less when a load of 4 kg/50 mm is imposed in the paper forming flow direction, and preferably the maximum fine hole diameter measured by a bubble point method is 25-50  $\mu$ m, and the electrolyte retention rate is 200% or higher. In this manufacturing method, the slurry is formed into a paper-like form by a wet paper manufacturing method, a sheet is formed by drying it, and a corona discharge treatment and a calender treatment are carried out to it after water stream entangling.

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## CLAIMS

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## [Claim(s)]

[Claim 1] The nonwoven fabric for alkaline battery separators which carried out paper making of the slurry which carried out 5-10 weight section combination of the polyvinyl alcohol binder fiber to nylon fiber 50 weight section - 80 weight section, heat welding fiber 50 - 20 weight sections, and the total amount 100 weight section of nylon fiber and heat welding fiber by the wet milling-paper method.

[Claim 2] The nonwoven fabric for alkaline battery separators according to claim 1 which corona discharge treatment of the aforementioned nonwoven fabric for alkaline battery separators is carried out after the stream confounding, and rate of adsorption is 100mm / 30 minutes or more, and is characterized by 4kg / 50mm load, or width contraction at the time of a beam being 6% or less in a paper-making flow direction about this nonwoven fabric.

[Claim 3] The nonwoven fabric for alkaline battery separators according to claim 1 or 2 characterized by for the maximum pore size measured by the bubble point method being 25-50 micrometers, and an electrolyte holding rate being 200% or more.

[Claim 4] The manufacture approach of the nonwoven fabric for alkaline battery separators characterize by carrying out paper making of the slurry in which polyvinyl alcohol binder fiber carried out 5-10 weight section combination to nylon fiber 50 weight section - 80 weight section , heat welding fiber 50 - 20 weight sections , and the total amount 100 weight section of nylon fiber and heat welding fiber by the wet milling - paper method , drying and performing corona discharge treatment and calender processing after a sheet , nothing , and stream confounding processing .

[Claim 5] The manufacture approach of the nonwoven fabric for alkaline battery separators characterized by to carry out paper making of the slurry in which polyvinyl alcohol binder fiber carried out 5-10 weight section combination to nylon fiber 50 weight section - 80 weight section, heat welding fiber 50 - 20 weight sections, and the total amount 100 weight section of nylon fiber and heat welding fiber by the wet milling - paper method, to dry and to remove polyvinyl-alcohol binder fiber from this sheet a sheet, nothing, and by carrying out stream confounding processing.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] About the nonwoven fabric for alkaline battery separators, and its manufacture approach, the short circuit prevention function of this invention is good, it is excellent in compatibility with the electrolytic solution, and a cell erector is related with the nonwoven fabric for alkaline battery separators with sufficient workability and its manufacture approach at the time.

[0002]

[Description of the Prior Art] It excels in a charge-and-discharge property and a overcharge overdischarge property, an alkaline battery is long lasting, and since it can be used repeatedly, it is widely used for the remarkable electronics device of the formation of small lightweight. It depends for the property of such an alkaline battery also on the property of the nonwoven fabric for alkaline battery separators greatly.

[0003] As a general function of the nonwoven fabric for alkaline battery separators, the following conditions are required.

- (1) A positive electrode and a negative electrode are physically separable.
- (2) Have the electric insulation for preventing a short circuit.
- (3) Have electrolytic-solution-proof nature.
- (4) Have electrochemical oxidation-proof nature.
- (5) Where the electrolytic solution is included, low electric resistance should be shown.
- (6) It is easy to get wet to the electrolytic solution, and the liquid retaining of the electrolytic solution is large.
- (7) Have the reinforcement and rigidity which can be borne like a cell erector.
- (8) Don't take out the harmful matter for a cell.
- (9) Excel in the oxygen gas permeability generated from an anode plate at the time of charge.

Therefore, the dry-type nonwoven fabric which consists of a polyolefin fiber of the sheath-core mold polyamide fibers, such as 6-nylon, 6, and 6-nylon, or whose heart component is polypropylene, and whose sheath component is polyethylene as a nonwoven fabric for alkaline battery separators has been used from the former.

[0004] However, since the nonwoven fabric for alkaline cell separators which consists of a nonwoven fabric of dry process has the large variation in a superintendent officer, a superintendent officer is made [ many ], and it is crushed and used in the heat calender, a mechanical strength is strong, and while excelling in cell workability, there is a trouble that a low superintendent officer cannot do. Consequently, when the inclination made to thin while making the amount of electrode active materials increase or decreasing the superintendent officer of a separator with high-capacity-izing of the latest cell is coped with, migration of an omission active material breaks out, or the problem on which the amount of maintenance of the electrolytic solution decreases arises.

[0005] As a means to solve these problems, the separator for alkaline batteries which consists of a melt blow nonwoven fabric is proposed. Since this melt blow nonwoven fabric consists of super-thin fiber, the pore size of a nonwoven fabric can be made small and high voidage can be obtained, while being able to prevent migration of an omission active material as a line to some extent, the amount of maintenance of the electrolytic solution can maintain thinning of an alkaline battery separator. However, the separator for alkaline batteries which consists of this melt blow nonwoven fabric, Since a high-speed heating air current is injected from both the side, fiber is thin-fibrosed, uptake of it is carried out and it is manufactured on a screen, carrying out melting prevention Since the problem and the permeability that a low superintendent officer cannot do below to some extent were low, when an electrode active material was made to increase, the reactant gas which occurs in large quantities could not be penetrated to a counter-electrode side, the internal pressure of a cell rose as the result, and there was a problem from which boosting charge becomes difficult.

[0006] Then, the separator for cells which carried out the laminating unification of the stream interlaced nonwoven fabric which consists of a melt blow nonwoven fabric and a staple fiber web by thermocompression bonding is proposed by JP,5-182654,A as a means to solve the above-mentioned trouble. While this separator for cells prevents migration of an electrode active material by the melt blow nonwoven fabric layer Although the solution retention of the electrolytic solution is improved and reinforcement, permeability, and the holdout of the electrolytic solution are made to improve by the stream interlaced nonwoven fabric layer, since productivity falls remarkably when the superintendent officer as the whole separator becomes large for producing this separator for cells to stability industrially, and this dares be made into a low superintendent officer, even the phase mass-produced has not been reached.

[0007] Moreover, the stream confounding of one or more sorts of thermoplastic staple fibers and heat welding fiber is mutually carried out to three dimensions, and the nonwoven fabric for battery separators which fused a part or all of heat welding fiber by heat treatment, and its manufacture approach are proposed by JP,7-26457,A and JP,8-185848,A. However, since a through tube will be formed and the maximum pore size was expanded while the remains of a confounding remain on a wet sheet when high-pressure stream processing is performed to a sheet and it dries on it in the state of a wet paper web in wet paper milling before drying a sheet that is, there was a fault that it became difficult to prevent migration of an active material completely. Moreover, when a tension started a separator in a cell configuration phase, contraction started the cross direction, and the electrode of an edge short-circuited, and it was easy to generate the Maki gap, and there was a fault that productive efficiency fell extremely in a cell assembly phase.

[0008]

[Problem(s) to be Solved by the Invention] This invention tends to solve the above problems, and a short circuit prevention function is well excellent in the compatibility of the electrolytic solution, and it aims at a cell erector offering the good nonwoven fabric for alkaline battery separators and its manufacture approach of workability at the time.

[0009]

[Means for Solving the Problem] In order to attain said purpose as a result of this invention person \*\*\*\* examination, it was able to attain from the following contents.

(1) Nylon fiber 50 - 80 weight sections, heat welding fiber 50 - 20 weight sections, And it consists of what carried out paper making of the slurry in which polyvinyl alcohol binder fiber carried out 5-10 weight section combination to the total amount of nylon fiber and heat welding fiber by the wet milling-paper method. (2) Corona discharge treatment of said alkaline battery nonwoven fabric is carried out after the stream confounding. Rate of adsorption is 100mm / 30 minutes or more, and width contraction at the time of 4kg / 50mm load, or a beam is 6% or less in a paper-making flow direction about this nonwoven fabric. (3) It has the description for the maximum pore size by which said nonwoven fabric for alkaline battery separators was measured by the bubble point method being 25-50 micrometers, and an electrolyte holding rate being 200% or more further. (4) Moreover, nylon fiber 50 - 80 weight sections, heat welding fiber 50 - 20 weight sections, Paper making of the slurry in which polyvinyl alcohol binder fiber carried out 5-10 weight section combination to the total amount of nylon fiber and heat welding fiber is carried out by the wet milling-paper method, and it dries. And nothing [ a sheet and nothing ], By carrying out stream confounding processing of the sheet which carried out paper making and which was the manufacture approach of the nonwoven fabric for alkaline battery separators of performing corona discharge treatment and calender processing, after stream confounding processing, and was dried by the (5) wet milling-paper method It is the manufacture approach of the nonwoven fabric for alkaline battery separators characterized by removing polyvinyl alcohol binder fiber from this sheet.

[0010] The nylon fiber used for this invention is intentionally used in respect of a hydrophilic property with the electrolytic solution as compared with a polyolefin fiber, it is independent or nylon 6, Nylon 66, Nylon 610, Nylon 612, nylon 10, and Nylon 12 can be used for it combining two or more kinds. It is desirable to use nylon 6 fiber at a point excellent in the hydrophilic property. Although there is especially no convention about the diameter of fiber, and fiber length, 6-14 micrometers of diameters of fiber and a thing with a fiber length of 5-10mm are used preferably. if it is in reinforcement and the inclination for width contraction to fall, in the diameter of fiber of less than 6mm, and the fiber length of less than 5mm and the diameter of fiber of 14 micrometers and the fiber length of 10mm are exceeded -- distribution and paper making -- carrying out -- \*\*\*\*\* -- it is in an inclination.

[0011] Although the bicomponent fiber of a sheath-core mold and a side-by-side mold or a single component type is mentioned, as for the heat welding fiber used for this invention, what is sheath-core type heat welding fiber, a sheath fuses, and a core part does not fuse from the point of width contraction and alkali resistance is desirable. If fusion with the dryer in wet paper milling and the dryer after a stream confounding is possible for the melting point of heat welding fiber, it is good and its melting point of 75-135 degrees C is more desirable. As concrete sheath-core heat welding fiber, a thing [ like an ethylene-vinylalcohol copolymer or polyethylene ] whose sheath component is has a desirable heart

component with polypropylene.

[0012] In case paper is milled by the wet milling-paper method, the polyvinyl alcohol binder fiber used for this invention ties the fiber which serves as a subject who constitutes a sheet, and it is used in order to give the sheet reinforcement in which bundling is possible by stream confounding processing. This polyvinyl alcohol binder fiber has that good in which the role which melts underwater easily at the process of stream confounding processing, and connects and ties between a broth and fiber is not only lost, but most is eluted. The hot water fusibility polyvinyl alcohol binder fiber the remelting temperature (potential melting temperature) after a melting temperature's being 50-90 degrees C, once dissolving at this temperature and drying the polyvinyl alcohol binder fiber used by this invention is 10-40 degrees C, and is [ fiber ] 90-97.5-mol % whenever [ saponification ] is used suitably. That is, since the melting temperature is high, in the water of ordinary temperature, i.e., cold water, without being eluted all over Hakusui, since it does not melt, hot water fusibility polyvinyl alcohol binder fiber remains in a sheet in the state of fiber, and is scattered between the fiber which serves as a subject, and the yield is good [ fiber ]. Moreover, since it dissolves with the heat of desiccation, and it is low, a melting temperature (potential melting temperature), i.e., remelting temperature, after drying, and dissolves easily in cold water, it is possible to dissolve easily at the process of stream confounding processing, and to carry out elution of the binder. About the configuration of polyvinyl alcohol binder fiber, although there is especially no convention, 9-35 micrometers of diameters of fiber and a thing with a fiber length of 3-10mm are used preferably. It is in the inclination for the binder effectiveness to fall that fiber length is less than 3mm, and when it exceeds 10mm, it is in the inclination which stops being able to carry out easily for paper making.

[0013] Next, combination of each fiber which constitutes the nonwoven fabric for alkaline battery separators is explained. Nylon fiber is [ 50 - 80 weight section and heat welding fiber ] 50 - 20 weight sections, and to the total amount 100 weight section of nylon fiber and heat welding fiber, polyvinyl alcohol binder fiber makes 5 - 10 weight section the shape of a slurry, and carries out paper making of the fiber combination which is this invention by the wet milling-paper method. Nylon fiber is under 50 weight sections, and although it is good about width contraction and the maximum pore size when heat welding fiber exceeds 50 weight sections, an electrolyte holding rate falls and it becomes a cell property top problem. Nylon fiber exceeds 80 weight sections, and although solution retention is good when heat welding fiber is under 20 weight sections, width contraction is large and it is in the inclination which the forward negative electrode short-circuits. Moreover, when the reinforcement on the front face of a sheet will be low, a through tube will be formed by the stream confounding of there being few loadings of heat welding fiber and the maximum pore size becomes large, it becomes difficult to prevent migration of an active material completely.

[0014] To the total amount of nylon fiber and heat welding fiber, the case of under 5 weight sections, the binder effectiveness falls and it is hard coming to carry out paper making of the polyvinyl alcohol binder fiber. Moreover, when 10 weight sections were exceeded, and it remains to the nonwoven fabric for alkaline battery separators and is made a cell even if polyvinyl alcohol binder fiber carries out stream confounding processing, by decomposing polyvinyl alcohol nature binder fiber with the electrolytic solution, a self-discharge property falls and it becomes a cell property top problem.

[0015] Corona discharge treatment of the nonwoven fabric for alkaline battery separators of this invention is carried out after the stream confounding, and it is the description that rate of adsorption is 100mm / 30 minutes or more, and 4kg / 50mm load, or width contraction at the time of a beam is 6% or less in a paper-making flow direction about this nonwoven fabric. Osmosis diffusion of the electrolytic solution is bad in rate of adsorption being 100mm / less than 30 minutes, and starting workability gets worse [ time amount ] to the electrolytic-solution impregnation at the time of cell assembly. Moreover, if 4kg / 50mm load, or width contraction at the time of a beam exceeds 6% for the nonwoven fabric for alkaline battery separators to a paper-making flow direction, in the case of cell assembly, at the process which winds a positive electrode, a negative electrode, and a separator around a curled form, a positive electrode and a negative electrode may short-circuit and a fatal defect may occur on a cell property.

[0016] Below, the manufacture approach of the nonwoven fabric for alkaline battery separators of this invention is explained. Nylon fiber, heat welding fiber, and polyvinyl alcohol binder fiber are mixed, and water is distributed and it considers as a slurry so that it may become 0.5 - 2% of concentration. Paper making of this slurry is carried out with the paper machine of a long network type, an inclined type long network type, or a round mesh type, and it is made to dry with a dryer. Although there is no convention in dryer temperature, it is in the inclination for the maximum pore size to become large because the surface reinforcement of a sheet becomes it weak that it is desirable to dry above the melting point of heat welding fiber, and it is under the heat welding fiber melting point. Thus, 45 - 70 g/m<sup>2</sup> sheet is created.

[0017] Next, a stream confounding is performed on the sheet obtained by wet paper milling. It is desirable to carry out stream confounding processing using the pillar-shaped stream jet which has the configuration where an injection tip is larger than the stream inlet attached to the interior of the injector of stream confounding equipment, in this invention. If

the above-mentioned pillar-shaped stream jet nozzle is used, there is little amount of water injected with the same water pressure, and since water spray-ization of a stream can be prevented, the confounding of the sheet can be carried out efficiently. Consequently, the irregularity of the remains of a confounding and a fitness pore size confounding sheet can be created, without disturbing the sheet obtained by the wet milling-paper method. The range of a pillar-shaped stream jet-nozzle pitch is 0.3-1.0mm, the diameter of a nozzle has desirable 150 micrometers or less from the point which can make pore size small, and its 100 micrometers or less are still more desirable. Although the approach of processing one side of a \*\*\*\*\* sheet by wet paper making is sufficient as the above-mentioned stream confounding, it is more desirable to carry out double-sided processing more preferably. Moreover, as for the water temperature at the time of performing stream confounding processing, it is more desirable than the re-dissolution temperature (potential dissolution temperature) of polyvinyl alcohol binder fiber that it is 3 degrees C or more. Stream confounding processing has the effectiveness which removes from a sheet the polyvinyl alcohol binder fiber which it not only carries out a confounding, but uses fiber by this invention. A part remains and it cannot remove completely except that there is a fault which must lengthen the stream confounding processing time in order to remove polyvinyl alcohol binder fiber when lower than remelting temperature. In order to perform stream confounding processing effectively and to remove polyvinyl alcohol binder fiber, it is desirable that water temperature is 3 degrees C or more from remelting temperature. Moreover, what is necessary is just to also carry out the count of processing, and water pressure according to the basis weight of a sheet that what is necessary is just to choose optimum conditions according to the purpose. By carrying out this stream confounding processing, the fiber which constitutes a sheet can carry out a confounding and the optimal maximum pore size can be obtained.

[0018] Next, corona discharge treatment is performed on the confounding sheet obtained by doing in this way. The electrode and polyester film which connected this corona discharge treatment to the high-voltage generating machine, Moderate spacing is prepared between the metal rolls covered with dielectrics, such as high PARON and silicon. The ozone which the electrical potential difference of thousands - tens of thousands V was applied by the RF, was made to generate a high-pressure corona, and was generated at this spacing, Or make atomic condition oxygen react, a carbonyl group, a carboxyl group, hydroxyl, and a peroxide radical are made to generate, and this hydrophilic group has contributed to improvement in compatibility with the electrolytic solution of a confounding sheet. Moreover, in case this corona discharge treatment is performed, an adult corona pinhole may be generated 0.2-1.0mm on a confounding sheet. As a standard of whether this corona pinhole is generated, when the maximum pore size of the confounding sheet after a stream confounding is larger than 60 micrometers, possibility that a corona pinhole will be generated is very high. In addition, it enables it to give the absorbency of the electrolytic solution, and solution retention by the cheap approach in this invention, although it may apply or sinking-in process by wetting agents, such as a surfactant of the Nonion system, after performing this corona discharge treatment, without depending on sinking-in processing of a surfactant by carrying out corona discharge treatment. As mentioned above, high absorbency and an electrolyte holding rate can be obtained by performing this corona discharge treatment.

[0019] Finally, about the sequence of corona discharge treatment and calender processing, although the sheet which performed corona discharge treatment performs calender processing and carries out thickness adjustment, even if reverse, there is especially no problem. That is, it is more desirable to carry out corona discharge treatment after calender processing at the point which it is more desirable to perform calender processing after corona discharge treatment, makes a confounding sheet smooth at the point which is easier to carry out corona discharge treatment for a confounding sheet to a deep part, and prevents generating of a corona pinhole. however, this invention should carry out wet paper milling, and should pass the process of stream confounding processing after desiccation -- it is so smooth that there is no fear of a corona pinhole being generated since it is, and since the maximum pore size is small, the former which is easy to carry out corona discharge treatment from the point of absorbency and solution retention to a deep part is more more desirable.

[0020] As material of roll used by calender processing, the thing of the combination of rubber-rubber, steel-steel, and steel-rubber, cotton-steel, and a cotton-cotton can be used. The point of the workability of thickness adjustment and the surface condition after calender processing to cotton-steel is desirable. Moreover, in order to be able to use it suitably as a nonwoven fabric for alkaline battery separators, it is desirable to measure thickness by the micrometer and to be referred to as 200 micrometers or less.

[0021] Furthermore, it is the description that the maximum pore size by which the nonwoven fabric for alkaline battery separators of this invention was measured by the bubble point method is 25-50 micrometers, and an electrolyte holding rate is 200% or more. When gas permeability gets worse that the maximum pore size is less than 25 micrometers, a charge-and-discharge life falls because cell internal pressure rises. Moreover, when the maximum pore size exceeds 50 micrometers, migration of an active material cannot be prevented completely but it is in the inclination to reduce a

battery life. Moreover, since [ so-called / which carries out a dryout ] it is compressed when the nonwoven fabric for alkaline battery separators carries out electrode swelling, and the electrolytic solution is extruded from the interior for alkaline battery separators of a nonwoven fabric by repeating charge and discharge as an electrolyte holding rate is less than 200%, a battery life falls.

[0022]

[Example] Hereafter, although an example explains this invention to a detail further, this invention is not limited to this example. In addition, all the sections in an example are based on weight.

[0023] In addition, the physical-properties value in an example and the example of a comparison is calculated by the following approach.

<Rate of adsorption> Rate of adsorption extracts three 2.5cmx18cm test pieces from the paper-making flow direction of a sample. A lower limit is arranged with the water flat bar, by the pin, each sample is stopped, and is given and lowered [ next, the water flat bar of predetermined height is installed on the tank into which the caustic potash (KOH) solution of specific gravity / in / for a test piece / 20\*\*2 degrees C / 1.3 (20-degrees C) was put, ], and the water flat bar is descended. It is the height in which the KOH solution went up by capillarity after the condition that the lower limit of each test piece was flooded into liquid only 5mm, nothing, and 30 minutes.

[0024] <Width contraction> Width contraction judges a sample in a width of 50mm, and die length of 150mm, and attaches a sample at intervals of [ of 60mm ] a span using a tensilon measurement machine (cage en tech company make, HTM-100). The mark is put on the core of the attached test piece, and width [ of the test piece of the part ] L (mm) is measured on a scale. Then, 4kg load or the width L1 of the test piece of the part which put the mark in the state of the beam (mm) is measured, and width contraction (%) is computed by the degree type.

Width contraction (%) =  $(L-L1) / L \times 100$  [0025] The <maximum pore size> The maximum pore size is measured by the bubble point method of ASTM-F-316 publication.

[0026] <Electrolyte holding rate> An electrolyte holding rate extracts three test pieces of 10cmx10cm magnitude from each sample, and measures weight [ when changing into a moisture parallel condition ] W (mg). Next, a test piece is opened and \*\*\*\*(ed) in the tank into which the caustic potash (KOH) solution of the specific gravity 1.3 (20 degrees C) in 20\*\*2 degrees C was put, it is left for 1 hour or more, it takes out out of liquid, one angle of a test piece is clipped and hung, weight W1 (mg) is measured after 10 minutes, and an electrolyte holding rate (%) is computed by the degree type.

Electrolyte holding rate (%) =  $(W1-W) / W \times 100$  [0027] Using a respectively well-known band-like sintering type nickel hydroxide electrode and a sintering type cadmium electrode every one sheet, the nonwoven fabric for alkaline battery separators of the following example and the example of a comparison was made to intervene among these electrodes, and it wound around the creation positive electrode and negative electrode of a cell, pulling this separator nonwoven fabric. And this was contained to cylindrical metal casing, the alkali electrolytic solution which makes the potassium hydroxide of specific gravity 1.30 a subject was poured in, the cell lid with a relief valve was attached, and nominal capacity created the direct-vent-system nickel-cadmium battery of 0.7Ah(s). The approach shown below estimated the cell property.

[0028] <Self-discharge property> Full charge of the created cell was carried out, and the self-discharge when saving for one month at 45 degrees was investigated.

O : 85%O:65 - 84%x:64% usable level is more than O, and remaining capacity (amount of 100%-self-discharge %) is the level on which O was improved remarkably.

[0029] <Cell assembly-operation nature> On the occasion of the above-mentioned cell assembly operation, the maximum speed of the configuration machine which can create a cell was evaluated.

O Workability is improper less than [ less than / more than :25 m/minO:20-25 m/minx:20 m/min / 20 m/min ].

[0030] <Poor leak> Resistance between the positive electrode of the created cell and a negative electrode was measured, the following [ 500kohm ] were made into poor leak, and poor leak lifting \*\*\*\*\* was expressed with % to the number which created the cell.

O When less than [ :1% ] O:2-3%x:3% is exceeded, O is usable level and the level on which O was improved remarkably.

[0031] <Cell internal pressure> The created cell was charged with the current of the rate of 1 time amount in 25 degrees C for 1.2 hours, and the internal pressure rise (kg) of 50 cycle repeat and the charge last stage was measured for the charge and discharge of discharging until terminal voltage is set to 1.0V with the current of the rate of 1 time amount.

O :2.4kg or less O:2.5-5.0kgx:5.1kg or more O is usable level and the level on which O was improved remarkably.

[0032] <liquid -- \*\*> -- the cell in front of a charge-and-discharge cycle is disassembled, and the amount V1 of

electrolytic-solution maintenance of a separator is measured. The cell which performed 300 times of charge-and-discharge cycles is disassembled, and the amount V2 of electrolytic-solution maintenance of a separator is measured. The liquid of a separator calculated  $V2/V1 \times 100$  as \*\*\*\*\*.

O In the case of not more than less than [ more than :85%O:70-84%x:69% ] 69%, the capacity fall of a cell occurs and it is impractical.

[0033] The 50 sections and polypropylene are heart components about 7.8 micrometers of diameters of example 1 fiber, and nylon fiber (henceforth Fiber A) with a fiber length of 5mm, The rate of a volume ratio of a sheath-core of a sheath component 17 micrometers of 50:50 diameters of fiber, [ an ethylene-vinylalcohol copolymer ] Heat welding fiber (henceforth Fiber B) with a fiber length of 10mm The 50 sections, 9.6mm of diameters of fiber, Distributed polyvinyl alcohol binder fiber (henceforth binder fiber) with a fiber length of 3mm by 5 \*\*\*\*\*, considered as 1% slurry of concentration, carried out paper making with the cylinder-mould type paper machine, it was made to dry at the dryer temperature of 120 degrees C, and the sheet of 60g/m<sup>2</sup> was created. And this sheet was conveyed on the porosity base material of 100 meshes which is a stainless steel wire, and the 35-degree C high-pressure pillar-shaped stream performed stream confounding processing by processing speed 15 m/min. As for a nozzle pitch, an injector uses the pillar-shaped stream jet nozzle 0.6mm and whose diameter of a nozzle are 100 micrometers using two sets, and water pressure carried out the confounding of one side of a sheet by 130kg/cm<sup>2</sup>, then carried out the confounding of the rear face, and was dried. Next, the gross energy per one side performed corona discharge treatment to both sides of the sheet obtained by carrying out in this way by part for 17.5kw(s), and m<sup>2</sup> using the electrode with a thickness [ of a flow direction ] of 20mm, and the ground roll which covered dielectric high PARON 3.2mm. Finally calender processing was performed in ordinary temperature, it measured by the micrometer with a diameter of 6.3mm, thickness was set to 150 micrometers, and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0034] Except having considered as the rate of combination which showed the fiber A used in the two to example 3 example 1, Fiber B, and binder fiber in Table 1, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0035] It considers as the rate of combination which showed the fiber A used in the example 4 example 1, Fiber B, and binder fiber in Table 1, and is the gross energy of 150kg/cm<sup>2</sup> and corona discharge treatment about the water pressure of stream confounding processing A part for 12.5kw(s), and m<sup>2</sup> Except having processed, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0036] It considers as the rate of combination which showed the fiber A used in the example 5 example 1, Fiber B, and binder fiber in Table 1, and is the water pressure of stream confounding processing 150kg/cm<sup>2</sup> Except having carried out, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0037] It considers as the rate of combination which showed the fiber A used in the example 6 example 1, Fiber B, and binder fiber in Table 1, and is the water pressure of stream confounding processing 80kg/cm<sup>2</sup> Except having carried out, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0038] Except having considered as the rate of combination which showed the fiber A used in the one to example of comparison 3 example 1, Fiber B, and binder fiber in Table 2, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 2.

[0039] Although the 70 sections and Fiber B were made into the 30 sections, the three sections were made into distribution and 1% slurry of concentration for binder fiber with water and paper making of the fiber A used in the example of comparison 4 example 1 was carried out with the cylinder-mould type paper machine, association between fiber was not able to obtain a sheet weakly. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 2.

[0040] the nylon fiber 50 section of 512.7 micrometers of examples of a comparison, and the nylon fiber 50 16.4-micrometer section -- KADO -- the nonwoven fabric of basis-weight 60 g/m<sup>2</sup> was produced by law, and it was made the thickness of 150 micrometers with the hot calender roll, and considered as the nonwoven fabric for alkaline battery

separators. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 2.

[0041] The result of the above-mentioned examples 1-3 and the examples 1-5 of a comparison is shown in Tables 1 and 2. It is inferior at the point which is in the inclination for internal pressure to become high when the gas permeability at the time of making it a cell according to the workability at the time of cell assembly getting worse according to rate of adsorption being bad although width contraction is good by the example 1 of a comparison having little nylon fiber as compared with an example, the maximum pore size being still smaller, and an electrolyte holding rate being low worsens, and liquid says as \*\*. Since width contraction is large and the maximum pore size is large, the example 2 of a comparison is inferior at the point called cell assembly-operation nature and poor leak that there is little heat welding fiber. A self-discharge property gets worse according to there being much polyvinyl alcohol binder fiber; and the example 3 of a comparison poses a cell property top problem. In the example 4 of a comparison, since there was little polyvinyl alcohol binder fiber, association between fiber became unable to mill paper weakly. About the nonwoven fabric for alkaline battery separators obtained by the dry type milling-paper method of the example 5 of a comparison, cell assembly-operation nature gets worse according to rate of adsorption being bad, and since width contraction is still larger, poor leak occurs and it becomes a cell property top problem.

[0042] The result of examples 4-6 is shown in Table 1. Examples 1-6 are all satisfactory on a cell property -- although it is in level, an example 1 is within the limits of claims 2 and 3 as compared with an example 1 and an example 4 and claim 3 of an example 4 is within the limits -- the rate of adsorption of claim 2 -- 100mm / 30 minutes or more -- it is -- width contraction -- 6.0% or less -- it is out of range. From things, an example 1 is in the level improved further in respect of cell assembly-operation nature and poor leak. although an example 2 is compared with an example 5, an example 2 is within the limits of claims 2 and 3, claim 2 of an example 5 is out of range and the electrolyte holding rate of claim 3 has \*\* to 200% or more further -- the 25-50 micrometers of the maximum pore size -- it is out of range. From this, an example 2 is in the level further improved in respect of cell assembly-operation nature, poor leak, and self-discharge. Moreover, it is in the level on which, as for the example 3 since [ whose maximum pore size of claim 3 is 25-50 micrometers although an example 3 is compared with an example 6, an example 3 is within the limits of claims 2 and 3 and an example 6 is within the limits of claim 2 ] it is out of range and is 200% or less of electrolyte holding rates, cell internal pressure and liquid were further improved in respect of \*\*.

[0043]

[Table 1]

	実施例					
	1	2	3	4	5	6
ナイロン繊維 部	50	80	70	50	80	70
熱融着繊維 部	50	20	30	50	20	30
バインダー繊維 部	5	10	7	5	10	7
坪量 g/m <sup>2</sup>	60.2	60.5	59.8	60.8	60.8	58.9
厚み μm	151	153	149	153	149	161
吸液速度 mm/30分	130	110	122	90	98	102
巾収縮率 %	1.4	5.5	3.5	6.5	7.0	3.1
最大細孔径 μm	27	48	37	48	55	22
保液率 %	220	320	302	250	380	190
自己放電	◎	◎	◎	◎	○	◎
電池組立作業性	◎	◎	◎	○	○	◎
リーク不良	◎	◎	◎	○	○	◎
電池内圧	◎	◎	◎	◎	◎	○
液がれ	◎	◎	◎	◎	◎	○

[0044]

[Table 2]

	比較例				
	1	2	3	4	5
ナイロン繊維 部	40	90	70	70	100
熱融着繊維 部	60	10	30	30	—
パインダー繊維 部	7	7	12	3	—
坪量 g/m <sup>2</sup>	60.5	60.6	59.6	—	60.0
厚み μ m	153	152	148	—	148
吸液速度 mm/30分	82	107	122	—	22
巾収縮率 %	1.0	10.0	1.8	—	7.5
最大細孔径 μ m	20	59	39	—	52
保液率 %	120	372	312	—	200
自己放電	◎	×	×	—	○
電池組立作業性	×	×	◎	—	×
リード不良	○	×	◎	—	×
電池内圧	×	○	◎	—	○
液がれ	×	◎	◎	—	○

[0045]

[Effect of the Invention] By this invention, it compared also as conventional one, and the short circuit prevention function was well excellent in the compatibility of the electrolytic solution, and turned into that it was possible to offer the nonwoven fabric for alkaline battery separators with sufficient workability and its manufacture approach at the time of cell assembly.

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TECHNICAL FIELD

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[Field of the Invention] About the nonwoven fabric for alkaline battery separators, and its manufacture approach, the short circuit prevention function of this invention is good, it is excellent in compatibility with the electrolytic solution, and a cell erector is related with the nonwoven fabric for alkaline battery separators with sufficient workability and its manufacture approach at the time.

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## PRIOR ART

[Description of the Prior Art] It excels in a charge-and-discharge property and a overcharge overdischarge property, an alkaline battery is long lasting, and since it can be used repeatedly, it is widely used for the remarkable electronics device of the formation of small lightweight. It depends for the property of such an alkaline battery also on the property of the nonwoven fabric for alkaline battery separators greatly.

[0003] As a general function of the nonwoven fabric for alkaline battery separators, the following conditions are required.

- (1) A positive electrode and a negative electrode are physically separable.
- (2) Have the electric insulation for preventing a short circuit.
- (3) Have electrolytic-solution-proof nature.
- (4) Have electrochemical oxidation-proof nature.
- (5) Where the electrolytic solution is included, low electric resistance should be shown.
- (6) It is easy to get wet to the electrolytic solution, and the liquid retaining of the electrolytic solution is large.
- (7) Have the reinforcement and rigidity which can be borne like a cell erector.
- (8) Don't take out the harmful matter for a cell.
- (9) Excel in the oxygen gas permeability generated from an anode plate at the time of charge.

Therefore, the dry-type nonwoven fabric which consists of a polyolefin fiber of the sheath-core mold polyamide fibers, such as 6-nylon, 6, and 6-nylon, or whose heart component is polypropylene, and whose sheath component is polyethylene as a nonwoven fabric for alkaline battery separators has been used from the former.

[0004] However, since the nonwoven fabric for alkaline cell separators which consists of a nonwoven fabric of dry process has the large variation in a superintendent officer, a superintendent officer is made [ many ], and it is crushed and used in the heat calender, a mechanical strength is strong, and while excelling in cell workability, there is a trouble that a low superintendent officer cannot do. Consequently, when the inclination made to thin while making the amount of electrode active materials increase or decreasing the superintendent officer of a separator with high-capacity-izing of the latest cell is coped with, migration of an omission active material breaks out, or the problem on which the amount of maintenance of the electrolytic solution decreases arises.

[0005] As a means to solve these problems, the separator for alkaline batteries which consists of a melt blow nonwoven fabric is proposed. Since this melt blow nonwoven fabric consists of super-thin fiber, the pore size of a nonwoven fabric can be made small and high voidage can be obtained, while being able to prevent migration of an omission active material as a line to some extent, the amount of maintenance of the electrolytic solution can maintain thinning of an alkaline battery separator. However, the separator for alkaline batteries which consists of this melt blow nonwoven fabric, Since a high-speed heating air current is injected from both the side, fiber is thin-fibrosed, uptake of it is carried out and it is manufactured on a screen, carrying out melting prevention Since the problem and the permeability that a low superintendent officer cannot do below to some extent were low, when an electrode active material was made to increase, the reactant gas which occurs in large quantities could not be penetrated to a counter-electrode side, the internal pressure of a cell rose as the result, and there was a problem from which boosting charge becomes difficult.

[0006] Then, the separator for cells which carried out the laminating unification of the stream interlaced nonwoven fabric which consists of a melt blow nonwoven fabric and a staple fiber web by thermocompression bonding is proposed by JP,5-182654,A as a means to solve the above-mentioned trouble. While this separator for cells prevents migration of an electrode active material by the melt blow nonwoven fabric layer Although the solution retention of the electrolytic solution is improved and reinforcement, permeability, and the holdout of the electrolytic solution are made to improve by the stream interlaced nonwoven fabric layer, since productivity falls remarkably when the superintendent officer as the whole separator becomes large for producing this separator for cells to stability industrially, and this dares

be made into a low superintendent officer, even the phase mass-produced has not been reached.

[0007] Moreover, the stream confounding of one or more sorts of thermoplastic staple fibers and heat welding fiber is mutually carried out to three dimensions, and the nonwoven fabric for battery separators which fused a part or all of heat welding fiber by heat treatment, and its manufacture approach are proposed by JP,7-26457,A and JP,8-185848,A. However, since a through tube will be formed and the maximum pore size was expanded while the remains of a confounding remain on a wet sheet when high-pressure stream processing is performed to a sheet and it dries on it in the state of a wet paper web in wet paper milling before drying a sheet that is, there was a fault that it became difficult to prevent migration of an active material completely. Moreover, when a tension started a separator in a cell configuration phase, contraction started the cross direction, and the electrode of an edge short-circuited, and it was easy to generate the Maki gap, and there was a fault that productive efficiency fell extremely in a cell assembly phase.

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EFFECT OF THE INVENTION

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[Effect of the Invention] By this invention, it compared also as conventional one, and the short circuit prevention function was well excellent in the compatibility of the electrolytic solution, and turned into that it was possible to offer the nonwoven fabric for alkaline battery separators with sufficient workability and its manufacture approach at the time of cell assembly.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] This invention tends to solve the above problems, and a short circuit prevention function is well excellent in the compatibility of the electrolytic solution, and it aims at a cell erector offering the good nonwoven fabric for alkaline battery separators and its manufacture approach of workability at the time.

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## MEANS

[Means for Solving the Problem] In order to attain said purpose as a result of this invention person \*\*\* examination, it was able to attain from the following contents.

(1) Nylon fiber 50 - 80 weight sections, heat welding fiber 50 - 20 weight sections, And it consists of what carried out paper making of the slurry in which polyvinyl alcohol binder fiber carried out 5-10 weight section combination to the total amount of nylon fiber and heat welding fiber by the wet milling-paper method. (2) Corona discharge treatment of said alkaline battery nonwoven fabric is carried out after the stream confounding. Rate of adsorption is 100mm / 30 minutes or more, and width contraction at the time of 4kg / 50mm load, or a beam is 6% or less in a paper-making flow direction about this nonwoven fabric. (3) It has the description for the maximum pore size by which said nonwoven fabric for alkaline battery separators was measured by the bubble point method being 25-50 micrometers, and an electrolyte holding rate being 200% or more further. (4) Moreover, nylon fiber 50 - 80 weight sections, heat welding fiber 50 - 20 weight sections, Paper making of the slurry in which polyvinyl alcohol binder fiber carried out 5-10 weight section combination to the total amount of nylon fiber and heat welding fiber is carried out by the wet milling-paper method, and it dries. And nothing [ a sheet and nothing ], By carrying out stream confounding processing of the sheet which carried out paper making and which was the manufacture approach of the nonwoven fabric for alkaline battery separators of performing corona discharge treatment and calender processing, after stream confounding processing, and was dried by the (5) wet milling-paper method It is the manufacture approach of the nonwoven fabric for alkaline battery separators characterized by removing polyvinyl alcohol binder fiber from this sheet.

[0010] The nylon fiber used for this invention is intentionally used in respect of a hydrophilic property with the electrolytic solution as compared with a polyolefin fiber, it is independent or nylon 6, Nylon 66, Nylon 610, Nylon 612, nylon 10, and Nylon 12 can be used for it combining two or more kinds. It is desirable to use nylon 6 fiber at a point excellent in the hydrophilic property. Although there is especially no convention about the diameter of fiber, and fiber length, 6-14 micrometers of diameters of fiber and a thing with a fiber length of 5-10mm are used preferably. if it is in reinforcement and the inclination for width contraction to fall, in the diameter of fiber of less than 6mm, and the fiber length of less than 5mm and the diameter of fiber of 14 micrometers and the fiber length of 10mm are exceeded -- distribution and paper making -- carrying out -- \*\*\*\*\* -- it is in an inclination.

[0011] Although the bicomponent fiber of a sheath-core mold and a side-by-side mold or a single component type is mentioned, as for the heat welding fiber used for this invention, what is sheath-core type heat welding fiber, a sheath fuses, and a core part does not fuse from the point of width contraction and alkali resistance is desirable. If fusion with the dryer in wet paper milling and the dryer after a stream confounding is possible for the melting point of heat welding fiber, it is good and its melting point of 75-135 degrees C is more desirable. As concrete sheath-core heat welding fiber, a thing [ like an ethylene-vinylalcohol copolymer or polyethylene ] whose sheath component is has a desirable heart component with polypropylene.

[0012] In case paper is milled by the wet milling-paper method, the polyvinyl alcohol binder fiber used for this invention ties the fiber which serves as a subject who constitutes a sheet, and it is used in order to give the sheet reinforcement in which bundling is possible by stream confounding processing. This polyvinyl alcohol binder fiber has that good in which the role which melts underwater easily at the process of stream confounding processing, and connects and ties between a broth and fiber is not only lost, but most is eluted. The hot water fusibility polyvinyl alcohol binder fiber the remelting temperature (potential melting temperature) after a melting temperature's being 50-90 degrees C, once dissolving at this temperature and drying the polyvinyl alcohol binder fiber used by this invention is 10-40 degrees C, and is [ fiber ] 90-97.5-mol % whenever [ saponification ] is used suitably. That is, since the melting temperature is high, in the water of ordinary temperature, i.e., cold water, without being eluted all over Hakusui, since it does not melt, hot water fusibility polyvinyl alcohol binder fiber remains in a sheet in the state of fiber, and is

scattered between the fiber which serves as a subject, and the yield is good [ fiber ]. Moreover, since it dissolves with the heat of desiccation, and it is low, a melting temperature (potential melting temperature), i.e., remelting temperature, after drying, and dissolves easily in cold water, it is possible to dissolve easily at the process of stream confounding processing, and to carry out elution of the binder. About the configuration of polyvinyl alcohol binder fiber, although there is especially no convention, 9-35 micrometers of diameters of fiber and a thing with a fiber length of 3-10mm are used preferably. It is in the inclination for the binder effectiveness to fall that fiber length is less than 3mm, and when it exceeds 10mm, it is in the inclination which stops being able to carry out easily for paper making.

[0013] Next, combination of each fiber which constitutes the nonwoven fabric for alkaline battery separators is explained. Nylon fiber is [ 50 - 80 weight section and heat welding fiber ] 50 - 20 weight sections, and to the total amount 100 weight section of nylon fiber and heat welding fiber, polyvinyl alcohol binder fiber makes 5 - 10 weight section the shape of a slurry, and carries out paper making of the fiber combination which is this invention by the wet milling-paper method. Nylon fiber is under 50 weight sections, and although it is good about width contraction and the maximum pore size when heat welding fiber exceeds 50 weight sections, an electrolyte holding rate falls and it becomes a cell property top problem. Nylon fiber exceeds 80 weight sections, and although solution retention is good when heat welding fiber is under 20 weight sections, width contraction is large and it is in the inclination which the forward negative electrode short-circuits. Moreover, when the reinforcement on the front face of a sheet will be low, a through tube will be formed by the stream confounding of there being few loadings of heat welding fiber and the maximum pore size becomes large, it becomes difficult to prevent migration of an active material completely.

[0014] To the total amount of nylon fiber and heat welding fiber, the case of under 5 weight sections, the binder effectiveness falls and it is hard coming to carry out paper making of the polyvinyl alcohol binder fiber. Moreover, when 10 weight sections were exceeded, and it remains to the nonwoven fabric for alkaline battery separators and is made a cell even if polyvinyl alcohol binder fiber carries out stream confounding processing, by decomposing polyvinyl alcohol nature binder fiber with the electrolytic solution, a self-discharge property falls and it becomes a cell property top problem.

[0015] Corona discharge treatment of the nonwoven fabric for alkaline battery separators of this invention is carried out after the stream confounding, and it is the description that rate of adsorption is 100mm / 30 minutes or more, and 4kg / 50mm load, or width contraction at the time of a beam is 6% or less in a paper-making flow direction about this nonwoven fabric. Osmosis diffusion of the electrolytic solution is bad in rate of adsorption being 100mm / less than 30 minutes, and starting workability gets worse [ time amount ] to the electrolytic-solution impregnation at the time of cell assembly. Moreover, if 4kg / 50mm load, or width contraction at the time of a beam exceeds 6% for the nonwoven fabric for alkaline battery separators to a paper-making flow direction, in the case of cell assembly, at the process which winds a positive electrode, a negative electrode, and a separator around a curled form, a positive electrode and a negative electrode may short-circuit and a fatal defect may occur on a cell property.

[0016] Below, the manufacture approach of the nonwoven fabric for alkaline battery separators of this invention is explained. Nylon fiber, heat welding fiber, and polyvinyl alcohol binder fiber are mixed, and water is distributed and it considers as a slurry so that it may become 0.5 - 2% of concentration. Paper making of this slurry is carried out with the paper machine of a long network type, an inclined type long network type, or a round mesh type, and it is made to dry with a dryer. Although there is no convention in dryer temperature, it is in the inclination for the maximum pore size to become large because the surface reinforcement of a sheet becomes it weak that it is desirable to dry above the melting point of heat welding fiber, and it is under the heat welding fiber melting point. Thus, 45 - 70 g/m<sup>2</sup> sheet is created.

[0017] Next, a stream confounding is performed on the sheet obtained by wet paper milling. It is desirable to carry out stream confounding processing using the pillar-shaped stream jet which has the configuration where an injection tip is larger than the stream inlet attached to the interior of the injector of stream confounding equipment, in this invention. If the above-mentioned pillar-shaped stream jet nozzle is used, there is little amount of water injected with the same water pressure, and since water spray-ization of a stream can be prevented, the confounding of the sheet can be carried out efficiently. Consequently, the irregularity of the remains of a confounding and a fitness pore size confounding sheet can be created, without disturbing the sheet obtained by the wet milling-paper method. The range of a pillar-shaped stream jet-nozzle pitch is 0.3-1.0mm, the diameter of a nozzle has desirable 150 micrometers or less from the point which can make pore size small, and its 100 micrometers or less are still more desirable. Although the approach of processing one side of a \*\*\*\*\* sheet by wet paper making is sufficient as the above-mentioned stream confounding, it is more desirable to carry out double-sided processing more preferably. Moreover, as for the water temperature at the time of performing stream confounding processing, it is more desirable than the re-dissolution temperature (potential dissolution temperature) of polyvinyl alcohol binder fiber that it is 3 degrees C or more. Stream confounding processing has the effectiveness which removes from a sheet the polyvinyl alcohol binder fiber which it not only carries

out a confounding, but uses fiber by this invention. A part remains and it cannot remove completely except that there is a fault which must lengthen the stream confounding processing time in order to remove polyvinyl alcohol binder fiber when lower than remelting temperature. In order to perform stream confounding processing effectively and to remove polyvinyl alcohol binder fiber, it is desirable that water temperature is 3 degrees C or more from remelting temperature. Moreover, what is necessary is just to also carry out the count of processing, and water pressure according to the basis weight of a sheet that what is necessary is just to choose optimum conditions according to the purpose. By carrying out this stream confounding processing, the fiber which constitutes a sheet can carry out a confounding and the optimal maximum pore size can be obtained.

[0018] Next, corona discharge treatment is performed on the confounding sheet obtained by doing in this way. The electrode and polyester film which connected this corona discharge treatment to the high-voltage generating machine, Moderate spacing is prepared between the metal rolls covered with dielectrics, such as high PARON and silicon. The ozone which the electrical potential difference of thousands - tens of thousands V was applied by the RF, was made to generate a high-pressure corona, and was generated at this spacing, Or make atomic condition oxygen react, a carbonyl group, a carboxyl group, hydroxyl, and a peroxide radical are made to generate, and this hydrophilic group has contributed to improvement in compatibility with the electrolytic solution of a confounding sheet. Moreover, in case this corona discharge treatment is performed, an adult corona pinhole may be generated 0.2-1.0mm on a confounding sheet. As a standard of whether this corona pinhole is generated, when the maximum pore size of the confounding sheet after a stream confounding is larger than 60 micrometers, possibility that a corona pinhole will be generated is very high. In addition, it enables it to give the absorbency of the electrolytic solution, and solution retention by the cheap approach in this invention, although it may apply or sinking-in process by wetting agents, such as a surfactant of the Nonion system, after performing this corona discharge treatment, without depending on sinking-in processing of a surfactant by carrying out corona discharge treatment. As mentioned above, high absorbency and an electrolyte holding rate can be obtained by performing this corona discharge treatment.

[0019] Finally, about the sequence of corona discharge treatment and calender processing, although the sheet which performed corona discharge treatment performs calender processing and carries out thickness adjustment, even if reverse, there is especially no problem. That is, it is more desirable to carry out corona discharge treatment after calender processing at the point which it is more desirable to perform calender processing after corona discharge treatment, makes a confounding sheet smooth at the point which is easier to carry out corona discharge treatment for a confounding sheet to a deep part, and prevents generating of a corona pinhole. however, this invention should carry out wet paper milling, and should pass the process of stream confounding processing after desiccation -- it is so smooth that there is no fear of a corona pinhole being generated since it is, and since the maximum pore size is small, the former which is easy to carry out corona discharge treatment from the point of absorbency and solution retention to a deep part is more more desirable.

[0020] As material of roll used by calender processing, the thing of the combination of rubber-rubber, steel-steel, and steel-rubber, cotton-steel, and a cotton-cotton can be used. The point of the workability of thickness adjustment and the surface condition after calender processing to cotton-steel is desirable. Moreover, in order to be able to use it suitably as a nonwoven fabric for alkaline battery separators, it is desirable to measure thickness by the micrometer and to be referred to as 200 micrometers or less.

[0021] Furthermore, it is the description that the maximum pore size by which the nonwoven fabric for alkaline battery separators of this invention was measured by the bubble point method is 25-50 micrometers, and an electrolyte holding rate is 200% or more. When gas permeability gets worse that the maximum pore size is less than 25 micrometers, a charge-and-discharge life falls because cell internal pressure rises. Moreover, when the maximum pore size exceeds 50 micrometers, migration of an active material cannot be prevented completely but it is in the inclination to reduce a battery life. Moreover, since [ so-called / which carries out a dryout ] it is compressed when the nonwoven fabric for alkaline battery separators carries out electrode swelling, and the electrolytic solution is extruded from the interior for alkaline battery separators of a nonwoven fabric by repeating charge and discharge as an electrolyte holding rate is less than 200%, a battery life falls.

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## EXAMPLE

[Example] Hereafter, although an example explains this invention to a detail further, this invention is not limited to this example. In addition, all the sections in an example are based on weight.

[0023] In addition, the physical-properties value in an example and the example of a comparison is calculated by the following approach.

<Rate of adsorption> Rate of adsorption extracts three 2.5cmx18cm test pieces from the paper-making flow direction of a sample. A lower limit is arranged with the water flat bar, by the pin, each sample is stopped, and is given and lowered [ next, the water flat bar of predetermined height is installed on the tank into which the caustic potash (KOH) solution of specific gravity / in / for a test piece / 20\*\*2 degrees C / 1.3 (20 degrees C) was put, ], and the water flat bar is descended. It is the height in which the KOH solution went up by capillarity after the condition that the lower limit of each test piece was flooded into liquid only 5mm, nothing, and 30 minutes.

[0024] <Width contraction> Width contraction judges a sample in a width of 50mm, and die length of 150mm, and attaches a sample at intervals of [ of 60mm ] a span using a tensilon measurement machine (cage en tech company make, HTM-100). The mark is put on the core of the attached test piece, and width [ of the test piece of the part ] L (mm) is measured on a scale. Then, 4kg load or the width L1 of the test piece of the part which put the mark in the state of the beam (mm) is measured, and width contraction (%) is computed by the degree type.

Width contraction (%) =  $(L-L1) / L \times 100$  [0025] The <maximum pore size> The maximum pore size is measured by the bubble point method of ASTM-F-316 publication.

[0026] <Electrolyte holding rate> An electrolyte holding rate extracts three test pieces of 10cmx10cm magnitude from each sample, and measures weight [ when changing into a moisture parallel condition ] W (mg). Next, a test piece is opened and \*\*\*\*(ed) in the tank into which the caustic potash (KOH) solution of the specific gravity 1.3 (20 degrees C) in 20\*\*2 degrees C was put, it is left for 1 hour or more, it takes out of liquid, one angle of a test piece is clipped and hung, weight W1 (mg) is measured after 10 minutes, and an electrolyte holding rate (%) is computed by the degree type.

Electrolyte holding rate (%) =  $(W1-W) / W \times 100$  [0027] Using a respectively well-known band-like sintering type nickel hydroxide electrode and a sintering type cadmium electrode every one sheet, the nonwoven fabric for alkaline battery separators of the following example and the example of a comparison was made to intervene among these electrodes, and it wound around the creation positive electrode and negative electrode of a cell, pulling this separator nonwoven fabric. And this was contained to cylindrical metal casing, the alkali electrolytic solution which makes the potassium hydroxide of specific gravity 1.30 a subject was poured in, the cell lid with a relief valve was attached, and nominal capacity created the direct-vent-system nickel-cadmium battery of 0.7Ah(s). The approach shown below estimated the cell property.

[0028] <Self-discharge property> Full charge of the created cell was carried out, and the self-discharge when saving for one month at 45 degrees was investigated.

O : 85%O:65 - 84%x:64% usable level is more than O, and remaining capacity (amount of 100%-self-discharge %) is the level on which O was improved remarkably.

[0029] <Cell assembly-operation nature> On the occasion of the above-mentioned cell assembly operation, the maximum speed of the configuration machine which can create a cell was evaluated.

O Workability is improper less than [ less than / more than :25 m/minO:20-25 m/minx:20 m/min / 20 m/min ].

[0030] <Poor leak> Resistance between the positive electrode of the created cell and a negative electrode was measured, the following [ 500kohm ] were made into poor leak, and poor leak lifting \*\*\*\*\* was expressed with % to the number which created the cell.

O When less than [ :1% ] O:2-3%x:3% is exceeded, O is usable level and the level on which O was improved

remarkably.

[0031] <Cell internal pressure> The created cell was charged with the current of the rate of 1 time amount in 25 degrees C for 1.2 hours, and the internal pressure rise (kg) of 50 cycle repeat and the charge last stage was measured for the charge and discharge of discharging until terminal voltage is set to 1.0V with the current of the rate of 1 time amount.

O : 2.4kg or less O:2.5-5.0kgx:5.1kg or more O is usable level and the level on which O was improved remarkably.

[0032] <liquid -- \*\*> -- the cell in front of a charge-and-discharge cycle is disassembled, and the amount V1 of electrolytic-solution maintenance of a separator is measured. The cell which performed 300 times of charge-and-discharge cycles is disassembled, and the amount V2 of electrolytic-solution maintenance of a separator is measured. The liquid of a separator calculated V2/V1x100 as \*\*\*\*\*

O In the case of not more than less than [ more than :85%O:70-84%x:69% ] 69%, the capacity fall of a cell occurs and it is impractical.

[0033] The 50 sections and polypropylene are heart components about 7.8 micrometers of diameters of example 1 fiber, and nylon fiber (henceforth Fiber A) with a fiber length of 5mm, The rate of a volume ratio of a sheath-core of a sheath component 17 micrometers of 50:50 diameters of fiber, [ an ethylene-vinylalcohol copolymer ] Heat welding fiber (henceforth Fiber B) with a fiber length of 10mm The 50 sections, 9.6mm of diameters of fiber, Distributed polyvinyl alcohol binder fiber (henceforth binder fiber) with a fiber length of 3mm by 5 \*\*\*\*\*, considered as 1% slurry of concentration, carried out paper making with the cylinder-mould type paper machine, it was made to dry at the dryer temperature of 120 degrees C, and the sheet of 60g/m<sup>2</sup> was created. And this sheet was conveyed on the porosity base material of 100 meshes which is a stainless steel wire, and the 35-degree C high-pressure pillar-shaped stream performed stream confounding processing by processing speed 15 m/min. As for a nozzle pitch, an injector uses the pillar-shaped stream jet nozzle 0.6mm and whose diameter of a nozzle are 100 micrometers using two sets, and water pressure carried out the confounding of one side of a sheet by 130kg/cm<sup>2</sup>, then carried out the confounding of the rear face, and was dried. Next, the gross energy per one side performed corona discharge treatment to both sides of the sheet obtained by carrying out in this way by part for 17.5kw(s), and m<sup>2</sup> using the electrode with a thickness [ of a flow direction ] of 20mm, and the ground roll which covered dielectric high PARON 3.2mm. Finally calender processing was performed in ordinary temperature, it measured by the micrometer with a diameter of 6.3mm, thickness was set to 150 micrometers, and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0034] Except having considered as the rate of combination which showed the fiber A used in the two to example 3 example 1, Fiber B, and binder fiber in Table 1, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0035] It considers as the rate of combination which showed the fiber A used in the example 4 example 1, Fiber B, and binder fiber in Table 1, and is the gross energy of 150kg/cm<sup>2</sup> and corona discharge treatment about the water pressure of stream confounding processing A part for 12.5kw(s), and m<sup>2</sup> Except having processed, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0036] It considers as the rate of combination which showed the fiber A used in the example 5 example 1, Fiber B, and binder fiber in Table 1, and is the water pressure of stream confounding processing 150kg/cm<sup>2</sup> Except having carried out, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0037] It considers as the rate of combination which showed the fiber A used in the example 6 example 1, Fiber B, and binder fiber in Table 1, and is the water pressure of stream confounding processing 80kg/cm<sup>2</sup> Except having carried out, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 1.

[0038] Except having considered as the rate of combination which showed the fiber A used in the one to example of comparison 3 example 1, Fiber B, and binder fiber in Table 2, it carried out like the example 1 and the nonwoven fabric for alkaline battery separators was obtained. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 2.

[0039] Although the 70 sections and Fiber B were made into the 30 sections, the three sections were made into

distribution and 1% slurry of concentration for binder fiber with water and paper making of the fiber A used in the example of comparison 4 example 1 was carried out with the cylinder-mould type paper machine, association between fiber was not able to obtain a sheet weakly. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 2.

[0040] the nylon fiber 50 section of 512.7 micrometers of examples of a comparison, and the nylon fiber 50 16.4-micrometer section -- KADO -- the nonwoven fabric of basis-weight 60 g/m<sup>2</sup> was produced by law, and it was made the thickness of 150 micrometers with the hot calender roll, and considered as the nonwoven fabric for alkaline battery separators. The above-mentioned examining method estimates the obtained nonwoven fabric for alkaline battery separators, and a result is shown in Table 2.

[0041] The result of the above-mentioned examples 1-3 and the examples 1-5 of a comparison is shown in Tables 1 and 2. It is inferior at the point which is in the inclination for internal pressure to become high when the gas permeability at the time of making it a cell according to the workability at the time of cell assembly getting worse according to rate of adsorption being bad although width contraction is good by the example 1 of a comparison having little nylon fiber as compared with an example, the maximum pore size being still smaller, and an electrolyte holding rate being low worsens, and liquid says as \*\*. Since width contraction is large and the maximum pore size is large, the example 2 of a comparison is inferior at the point called cell assembly-operation nature and poor leak that there is little heat welding fiber. A self-discharge property gets worse according to there being much polyvinyl alcohol binder fiber, and the example 3 of a comparison poses a cell property top problem. In the example 4 of a comparison, since there was little polyvinyl alcohol binder fiber, association between fiber became unable to mill paper weakly. About the nonwoven fabric for alkaline battery separators obtained by the dry type milling-paper method of the example 5 of a comparison, cell assembly-operation nature gets worse according to rate of adsorption being bad, and since width contraction is still larger, poor leak occurs and it becomes a cell property top problem.

[0042] The result of examples 4-6 is shown in Table 1. examples 1-6 are all satisfactory on a cell property -- although it is in level, an example 1 is within the limits of claims 2 and 3 as compared with an example 1 and an example 4 and claim 3 of an example 4 is within the limits -- the rate of adsorption of claim 2 -- 100mm / 30 minutes or more -- it is -- width contraction -- 6.0% or less -- it is out of range. From things, an example 1 is in the level improved further in respect of cell assembly-operation nature and poor leak. although an example 2 is compared with an example 5, an example 2 is within the limits of claims 2 and 3, claim 2 of an example 5 is out of range and the electrolyte holding rate of claim 3 has \*\* to 200% or more further -- the 25-50 micrometers of the maximum pore size -- it is out of range. From this, an example 2 is in the level further improved in respect of cell assembly-operation nature, poor leak, and self-discharge. Moreover, it is in the level on which, as for the example 3 since [ whose maximum pore size of claim 3 is 25-50 micrometers although an example 3 is compared with an example 6, an example 3 is within the limits of claims 2 and 3 and an example 6 is within the limits of claim 2 ] it is out of range and is 200% or less of electrolyte holding rates, cell internal pressure and liquid were further improved in respect of \*\*.

[0043]

[Table 1]

	実施例					
	1	2	3	4	5	6
ナイロン繊維 部	50	80	70	50	80	70
熱融着繊維 部	50	20	30	50	20	30
パインダー繊維 部	5	10	7	5	10	7
坪量 g/m <sup>2</sup>	60.2	60.5	59.8	60.8	60.8	58.9
厚み μm	151	153	149	153	149	161
吸液速度 mm/30分	130	110	122	90	98	102
巾収縮率 %	1.4	5.5	3.5	6.5	7.0	3.1
最大細孔径 μm	27	48	37	48	55	22
保液率 %	220	320	302	250	380	190
自己放電	◎	◎	◎	◎	○	◎
電池組立作業性	◎	◎	◎	○	○	◎
リード不良	◎	◎	◎	○	○	◎
電池内圧	◎	◎	◎	◎	◎	○
液がれ	◎	◎	◎	◎	◎	○

[0044]

[Table 2]

	比較例				
	1	2	3	4	5
ナイロン繊維 部	40	90	70	70	100
熱融着繊維 部	60	10	30	30	—
パインダー繊維 部	7	7	12	3	—
坪量 g/m <sup>2</sup>	60.5	60.6	59.6	—	60.0
厚み μ m	153	152	148	—	148
吸液速度 mm/30分	82	107	122	—	22
巾収縮率 %	1.0	10.0	1.8	—	7.5
最大細孔径 μ m	20	59	39	—	52
保液率 %	120	372	312	—	200
自己放電	◎	×	×	—	○
電池組立作業性	×	×	◎	—	×
リード不良	○	×	◎	—	×
電池内圧	×	○	◎	—	○
液がれ	×	◎	◎	—	○

[Translation done.]